A Taxonomy of Human and Environmental Factors Related to Pediatric Patient Falls

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Chapter I

Statement of the Problem

Introduction

Parents expect their hospitalized children to be protected from harm; yet, among 26 children's hospitals of varying sizes, from 1 to 9 of every 83 hospitalized children per year fall (CDC, 2008) from their beds, cribs, chairs, couches, or stools, or slip, trip, and fall to the floor. Failure to prevent patient falls may result in injuries to the patient that prolong the hospital stay and lead to unnecessary complications. The fall of a child may also decrease family and patient trust in the healthcare team. Therefore, it is evident that pediatric patient falls are a disconcerting event in the hospital setting.

Typical hospital and unit culture is to blame parents for their lack of vigilance, and children for their exuberance. Hospitals use pediatric fall risk assessment scales to predict which patients are at highest risk for falling so that those patients will receive additional fall prevention interventions. A critique of four popular fall risk assessment tools revealed precision and accuracy levels well below epidemiological standards for instruments used to make patient care decisions. Hospitals need a paradigm shift from faulty predictions and blame, to accepting responsibility for patient falls as medical errors.

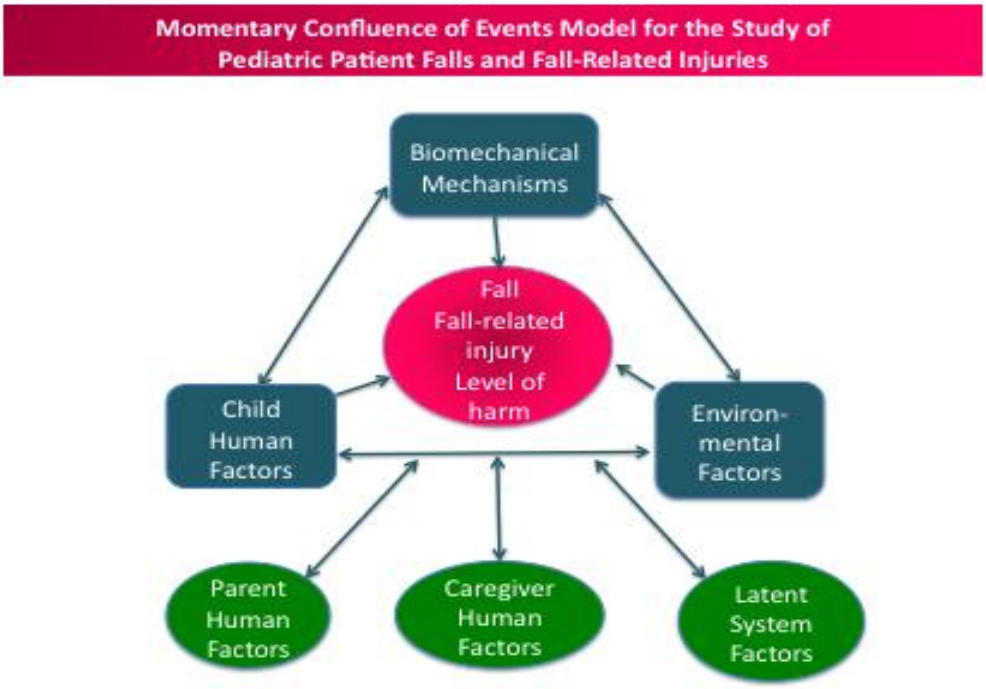
Purpose of the Study

The purpose of this retrospective medical record review is to develop a taxonomy of the characteristics of pediatric patient falls and factors that contribute to falls. We expect to identify many content categories that reflect human factors related to the child, parents, and caregiver and environmental factors. This new taxonomy will represent beginning theory development on the phenomenon of pediatric patient falls, and may provide direction for new fall prevention interventions.

Conceptual Model

The Institute of Medicine, *Quality Chasm* reports (Institute of Medicine, 2001) and Wood's taxonomy of pediatric adverse events (Woods et al., 2005), suggests that errors are the result that errors are the result of human factors, environmental factors, and latent systems factors. For the study of pediatric patient falls we characterize human factors of the child, the parent, and the caregiver. In addition, fall related injuries are a direct function of child human factors, environmental factors, and biomechanical mechanisms. Thus, we propose that pediatric patient falls and injuries are caused by "a momentary confluence of human, environmental, biomechanical, and hospital system factors" (Figure 1).

Figure 1



Research Questions

1. What human factors contribute to pediatric patient falls?
2. What environmental factors are involved in pediatric patient falls?

Limitations

This was a retrospective record review and, therefore, the data on these factors are limited to what is written in medical records and AERs. Ideally, interviews with parents, caregivers, and the children if applicable would yield additional descriptive data. The sample size of 93 subjects was sufficient to begin the development of taxonomy, but, many more subjects would be needed to develop a comprehensive taxonomy.

Chapter II

Review of the Literature

Target Population

The CDC (2008) National Hospital Discharge Survey data indicate that 2,298,000 children ages 1 to 15 years were hospitalized in 2006, with an average length of stay of 4.8 days (SE=0.2). Children ages 1 to 15 years accounted for 21,109,000 ambulatory visits in 2005 (Middleton, Hing & Xu, 2007). The potential number of patients who could fall during hospitalization or clinic visits is enormous.

Pediatric Patient Falls

A patient fall is an unplanned descent to the floor with or without injury to the patient (Kingston, Bryant & Speer, 2010). A fall can occur due to physiologic reasons, for example fainting, or environmental reasons such as slippery floors (Kingston, Bryant & Speer). Only a handful of published studies and a study recently conducted by Ryan-Wenger, et al. (in press) describe the incidence and types of pediatric patient falls in hospitals. Table 1 summarizes the scope of these studies. Falls from a height account for 37.5% to 51.4% of falls, while falls from standing positions range from 26.4% to 62.5% of all falls.

Table 1

Studies on the incidence and types of pediatric patient falls in hospitals.

Banco & Powers, 1988	3-year data from one 53-bed hospital 51 incident reports 35 of 51 (61%) incidents due to falls	18 falls (51.4%) from a high crib or bed 15 falls (42.9%) from standing on the floor 2 falls (5.7%) from a wheelchair
Levene & Bonfield, 1991	18-month data from 8 hospitals 781 incident reports 421 of 781 (54%) due to falls	177 falls (42%) from a height 111 falls (26.4%) from slips and trips 133 falls (31.6%) from unreported surfaces
Child Health Corporation of America (CHCA), 2009	6-month falls data from 26 children's hospitals 770 children fell	289 falls (37.5%) from a height 481 falls (62.5%) from standing on the floor
Ryan-Wenger, et al., in press	7 years of falls data from one 256-bed children's hospital 531 children fell	244 falls (46%) from a height 219 falls (49.3%) from standing on the floor 25 falls (4.7%) from unknown positions
Razmus, Wilson, Smith & Newman, 2006	100 children fell One children's hospital	22 falls (22%) while getting in/out of bed 20 falls (20%) while going to the bathroom

Most pediatric patients are not alone when they slip, trip, or fall. In a Child Health Corporation of America (CHCA, 2009) study of 26 children's hospitals, 770 falls occurred over a 6-month period; 550 (71.4%) of the falls were witnessed by a caregiver or parent. Coincidentally, Ryan-Wenger's study of 652 hospitalized children's falls over a 7 year period showed that 379 (71.4%) of falls were witnessed by a caregiver, parent or family member (Ryan-Wenger, et al., in press). These studies minimally described the outcomes of children's falls in terms of *injuries*. In the CHCA study, 307 of 770 (39.9%) children were injured from their falls. Similarly, of 531 children who fell in Ryan-Wenger's study, 229 (43.1%) of them were injured. The types and severity of injuries were poorly documented in event reporting systems, so no patterns could be observed. No studies have examined the problem of falls in pediatric clinics, but a review of all falls in our hospitals' event reporting system indicates that there are about half as many reported falls in the clinics than in the hospital.

Poor Performance of Fall Risk Assessment Tools

Research on the causes, risks, and prevention of *pediatric falls* is quite recent, and therefore, sparse, but there are lessons to be learned from 20 years of research on falls in adult and elderly patients. Falls remain a significant clinical problem with adult and elderly patients. Oliver (2006), the developer of a popular fall risk scale for adults, suggests that the clinical use of fall risk scales be abandoned because they do not adequately predict individuals who fall, and give nurses a false sense of security that "something is being done" about falls (p. 89). As described below, a pattern similar to the adult fall risk literature is emerging in pediatrics, and we should not wait 20 years to change our approach to studying the problem of pediatric falls and injuries.

A critical review of four commonly used pediatric fall risk scales (Ryan-Wenger et al., in press) suggests that it may be fruitless to try to predict pediatric patients who might fall (Ryan-Wenger et al., in press). The four tools include the General Risk Assessment for Pediatric Inpatient Falls (GRAF-PIF), the Humpty-Dumpty Falls Scale, the CHAMPS Pediatric Fall Risk Assessment Tool, and the Pediatric Fall Risk Assessment Tool (PFRAT) (Graf, 2005; Hill-Rodriquez, et al., 2008; Razmus, et al., 2006; Ryan-Wenger, et al., in press). The instruments contain 5, 7, 4 and 10 items respectively. High fall risk scores are meant to trigger implementation of additional fall prevention interventions. In epidemiologic research, the term "risk factor" generally refers to variables that can be altered by specific interventions, yet all but one of the pediatric fall risk factors are characteristics of the children that are not modifiable, such as age, gender, diagnosis, physical disability, medications, cognitive impairment, surgery, previous fall, voiding patterns, and length of stay. Only the CHAMPS scale includes one environmental variable which has to do with the developmental appropriateness of the children's bed type (full bed, crib). Inter-rater reliability of scoring was reported for the Humpty-Dumpty (>70% agreement), the CHAMPS (80% to 100% agreement) and the PFRAT (55.1% agreement). Reliability of the GRAF-PIF was not reported. These four instruments fall short of the goal of consistent reliability levels > 95%, when scores are used to make treatment decisions (Nunnally & Bernstein, 1994). Adequate reliability is required for validity of scores. Retrospective case-control studies tested the accuracy (validity) of these four instruments' in predicting fallers from non-fallers. Sensitivities ranged from 75% to 85.3%, and specificities from 24.3% to 76%. False positive and false negative errors ranged from 14.7% to 75.7% (Ryan-Wenger, et al., in press). It is important to note that reliability and validity errors are cumulative (Nunnally & Bernstein). These fall risk tools are widely adopted by children's hospitals as part of their Joint Commission-mandated fall risk prevention programs, but clearly, they deliver false confidence in their predictive ability.

Chapter III

Methodology

Specific Aim: To develop a taxonomy of factors related to pediatric patient falls.

Research questions:

1. What human factors contribute to pediatric patient falls?
2. What environmental factors are involved in pediatric patient falls?

Research Design

The research design is a retrospective medical record review and it is a descriptive study.

Population and Sample Size

The target population is hospitalized children ages birth to 21 years. Inclusion criteria for the sample are all children ages birth to 21years between 2002-2008 for whom an adverse event report for a fall was documented. There are no exclusion criteria which makes the information much more generalizable because we are not narrowing the population. Sample size includes 93 pediatric patients ages 1 month to18 years who fell between 2002-2008. A sample size of 93 should provide the variability as well as redundancy required to identify mutually exclusive and exhaustive categories of factors that contribute to pediatric patient falls. Demographic characteristics of the children will be obtained from the medical records.

Data Collection Procedures

Descriptions of falls were obtained from Adverse Event Reports and categories of human and environmental factors were inductively derived from the descriptions.

Data Collection Instrument

Clinical demographic form includes characteristics of child- age, sex, developmental status, diagnosis, length of hospital stay, day of the week the child fell, and the shift that the child fell. An Excel file was developed of the content form the adverse event report that describes the circumstances of the fall. Columns were added for text related to the following factors- fall from what, fall onto what, child's action leading to fall, child fell in the presence of whom, where did the child fall, human environmental factors, and factors related to the child, mother, other visitors, and nurse.

Data Analysis

Characteristics of the sample are reported in a table with frequencies and percentages. A systematic content analysis method developed by McLaughlin and Marascuilo (1990) was used to inductively derive categories of contributing factors from the Adverse Event Reports. Categories will be reported by frequencies and percentages. The primary investigator inductively categorized portions of the text into pre-determined categories (deductive). A second investigator independently categorized 10% of the cases. IRR was 90%.

Chapter IV

Research Results

Child Human Factors

The sample (N=93) consisted of children ages 1 month to 18 years (Table 2). Of the children who fell 59.1% were male and 38.7% were female. From the developmental age category toddlers (1-2 years), were most likely to fall at 25.8%. The average age of a fall was 6.8 years and the median age was 4.6 years. In addition, 81.3% of the children were at the appropriate developmental age, 11.0% were delayed or had mental retardation, and for 7.7% the developmental status was unknown. The three leading primary diagnoses of the children who fell were neurologic/developmentally delayed (33.3%), hematology/oncology (21.5%), and gastrointestinal disorders (11.8%). Over one-third (36.6%) of the children were of a normal/healthy acuity level, 29.0% were categorized as having mild systemic disease, and 8.8% had severe systemic disease. At the time of the fall the children were ambulating (26.9%), getting out of bed (11.8%), playing (11.8%), standing up (10.8%), lying down (9.7%), sitting (9.7%), using the toilet (4.3%), sleeping (3.2%), jumping/dancing (2.2%), being held by an adult (2.2%), and being pushed in a wheelchair (1.1%). The length of hospitalization at the time that most children fell was 1 day (19.4%) and 2 days (17.2%) with a range of 1 day to 117 days.

Table 2

Child Human Factors

	Frequency	%
Gender		
Male	55	59.1
Female	36	38.7
Race		
White	66	71.0
Black	22	23.7
Other	5	5.4
Developmental Age		
Infancy (birth- 12 months)	9	9.7
Toddler (13- 35 months)	24	25.8
Preschool (36- 59 months)	13	14.0
Young School Aged (60- 83 months)	5	5.4
School Aged (84-143 months)	19	20.4
Young Adolescent (144-179 months)	9	9.7
Adolescent (180- 216 months)	12	12.9
Developmental Status		
Appropriate for Age	74	79.6
Delayed/Mental Retardation	10	10.8
Unknown	7	7.5
Primary Diagnosis		
Neurologic/Developmental Delay	31	33.3
Hematology/Oncology	20	21.5
Gastrointestinal	11	11.8
Infectious Disease	8	8.6
Respiratory	8	8.6
Cardiac	4	4.3
ENT	3	3.2
Renal	2	2.2
Unknown	2	2.2
Metabolic/Endocrine	1	1.1
Acuity Level		
Normal, Healthy	34	36.6
Mild systemic disease	27	29.0
Severe systemic disease	8	8.6
Unassigned	6	6.8
Activity at the time of fall		
Ambulating	25	26.9

Getting out of bed	11	11.8
Playing	11	11.8
Standing up	10	10.8
Lying down	9	9.7
Sitting	9	9.7
Using the toilet	4	4.3
Sleeping	3	3.2
Jumping/Dancing	2	2.2
Being held by adult	2	2.2
Being pushed in wheelchair	1	1.1

Parent/Staff Human Factors

In 67.7% of the cases (Table 3), there was at least one adult in the room. The adults include parents and family members (60.2%) and staff members (30.1%). In some cases, human factors contributed to the falls. Parents were distracted (6.5%), asleep (5.4%), helping the patient (5.4%), and holding the patient (2.2%). Staff members were communicating with parents (2.2%) working with equipment (2.2%), and helping the patient (1.1%).

Table 3

Parent Human Factors

	Frequency	%
Distracted	6	6.5
Asleep	5	5.4
Helping the patient	5	5.4
Holding the patient	2	2.2

Staff Human Factors

	Frequency	%
Communicating with parents	2	2.2
Working with equipment	2	2.2
Helping patient	1	1.1
Lost control of patient	1	1.1

Environmental Factors

The majority of children fell (Table 4) on day shift (49.5%) and evening shift (40.9%), whereas only 9.7% fell on night shift. Falls were near evenly spread throughout the week. Some falls occurred due to equipment being in the way (4.3%), side rails being left down (3.2%), equipment being improperly set up (1.1%), and the floor being slippery (1.1%).

Table 4

Environmental Factors

	Frequency	%
Shift that patient fell		
Days (0700-1459)	46	49.5
Evenings (1500-2259)	38	40.9
Nights (2300-0659)	9	9.7
Day of the week patient fell		
Sunday	13	14.0
Monday	15	16.1
Tuesday	13	14.0
Wednesday	15	16.2
Thursday	15	16.1
Friday	10	10.8
Saturday	12	12.9
Equipment in the way	4	4.3
Side rails down	3	3.2
Equipment improperly set up	1	1.0
Floor slippery	1	1.0

Fall Characteristics

The majority of the falls (Table 5) occurred in the patient room (76.3%) where other falls occurred in the hallway (9.7%), bathroom (6.5%), playroom (2.2%), and at therapy (2.2%). Many children fell from a standing level to the floor (41.9%), almost a quarter fell from their bed (23.8%), while others fell from a chair/couch/wheelchair (11.8%), crib (7.5%), or other equipment (3.2%). The majority of children fell onto the floor (82.8%), while others fell onto equipment (7.5%), the couch (2.2%), and their toys (1.1%).

Table 5

Fall Characteristics

	Frequency	%
Location of fall		
Patient room		
Hallway	69	76.3
Bathroom	9	9.7
Playroom	6	6.5
Therapy site	2	2.2
	2	2.2
Fell from:		
Standing level to floor		
Bed	39	41.9
Chair, couch, wheelchair	22	23.7
Crib	11	11.8
Equipment (swing, IV pole)	7	7.5
	3	3.2
Fell onto:		
Floor		
Equipment	77	82.8
Couch	7	7.5
Toys	2	2.2
	1	1.1

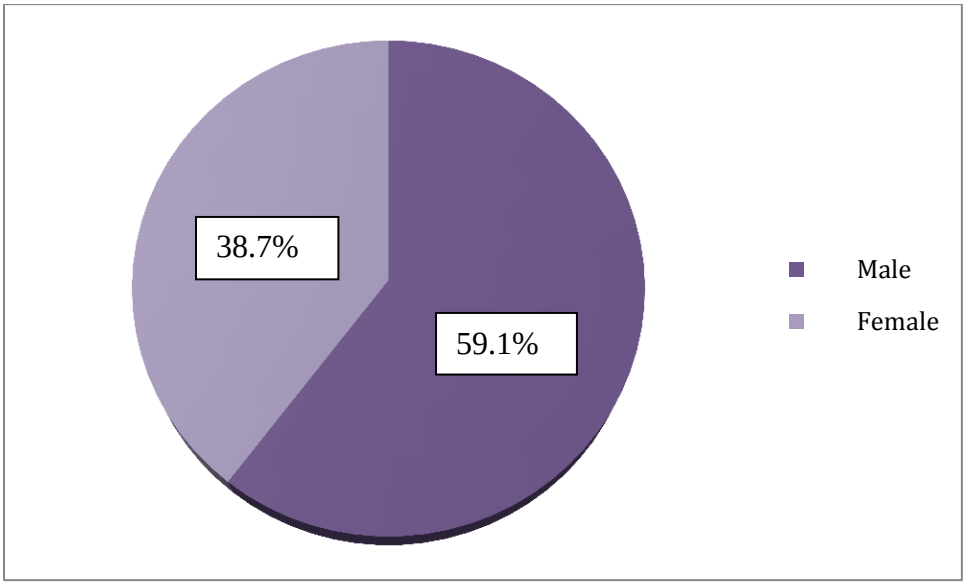
Chapter V

Discussion

Gender- Males (59.1%) were more likely to fall (Figure 2) than females (38.7%). Males are more likely to participate in rough and tumble activity, whereas girls engage in more relaxing activities.

Figure 2

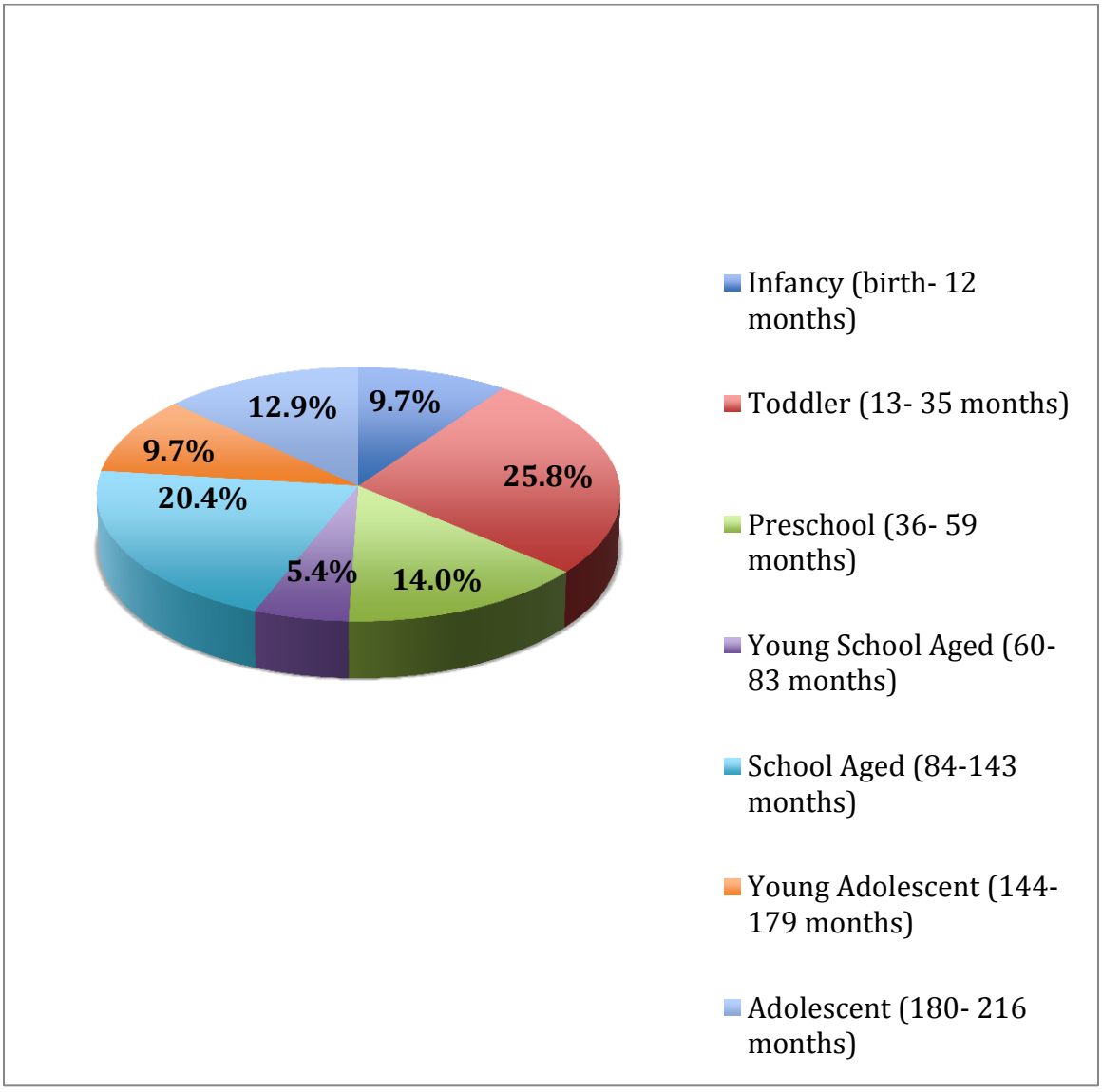
Patient Gender



Developmental age- Toddlers (25.8%) ages 13-35 months (Figure 3) were the developmental age group that was most likely to fall (Figure 2). Toddlers are at the developmental age where they are striving for autonomy (Erikson, 1963). They want to perform tasks on their own and restrictions and limitations can cause resistance from this age group. Toddlers like consistency with routines, which are greatly disrupted in the hospital setting. Unfamiliar settings, disrupted rituals, and separation from parents cause stress in the toddler contributing to their falls (Hockenberry & Wilson, 2007). School aged children (20.4%) ages 84-143 months (7 years -11 years 11 months) were the second leading developmental age group to fall. School age children are industrious and they try to gain independence (Erikson, 1963). They are vulnerable when their feelings of control are disrupted. While they are in the hospital, they are unable to make their own choices, which adds to their stress and may contribute to their risk of falls (Hockenberry & Wilson, 2007). Preschoolers (14.0%) ages 36-59 months were the third leading age group to fall. Preschoolers have an egotistical thought process that limits their understanding of events (Piaget, 1988). They lack abstract thinking and are used to routines. In the hospital setting, they may be unable to understand their surroundings and their usual routines are disrupted (Hockenberry &Wilson, 2007).

Figure 3

Developmental age



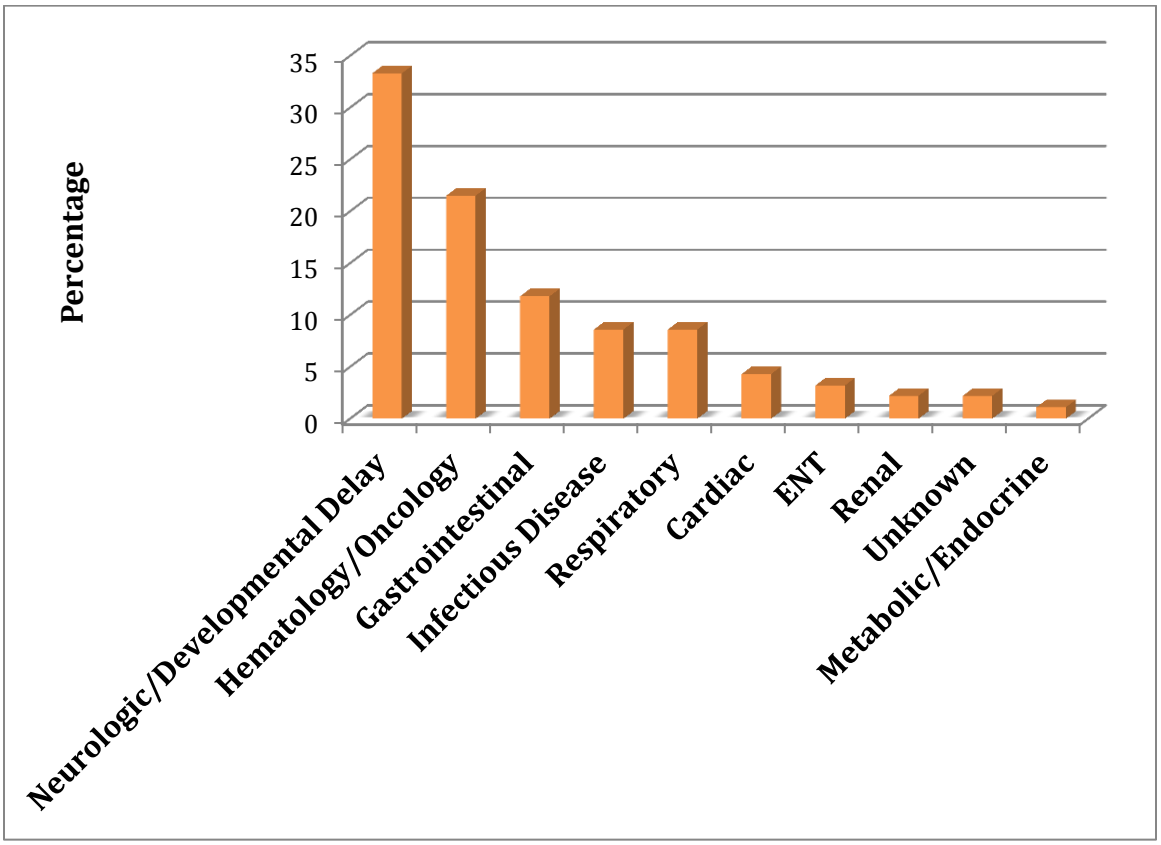
Developmental status- Of the children who fell, 10.8% were developmentally delayed or had mental retardation. A child who is developmentally delayed or who has mental retardation may be unable to understand simple instructions and they may not understand why they are admitted to the hospital. They may be more afraid of unfamiliar surroundings and personnel, thus causing them to get out of bed on their own. The majority of children who fell were developmentally normal (79.6%) but they were also in an unfamiliar environment and confined to a small space. For example, children in the hospital are restricted to a small space such as their room or a crib where in a more normal environment they would be more mobile. Their normal inclinations to be active and explore can be hazardous in a hospital environment.

Diagnosis – The majority of the patients who fell had a primary diagnosis (Figure 4) of Neurologic/Developmental Delay (33.3%). These children may not be alert and oriented and their judgment and cognition may be impaired. They may be unable to understand simple instructions and may be unable to make logical decisions. They may be confused and disoriented and have a lengthy hospital stay. Children with neurologic dysfunction are often restless and irritable. All of these factors put them at a higher risk for falling during their hospital stay. Hematology/Oncology was the next leading primary diagnosis of the children who fell (21.5%). These children often have very lengthy hospital stays where stress, boredom and curiosity may play a factor in the children falling. They may also be attached to IV lines and other equipment that contribute to the fall. Of the children, 11.8% had a primary diagnosis of a gastrointestinal disorder. Babies who are born premature often have gastrointestinal problems and spend much of their childhood

in the hospital. Children with gastrointestinal disorders may have lengthy hospital stays where boredom and curiosity contribute to their falls.

Figure 4

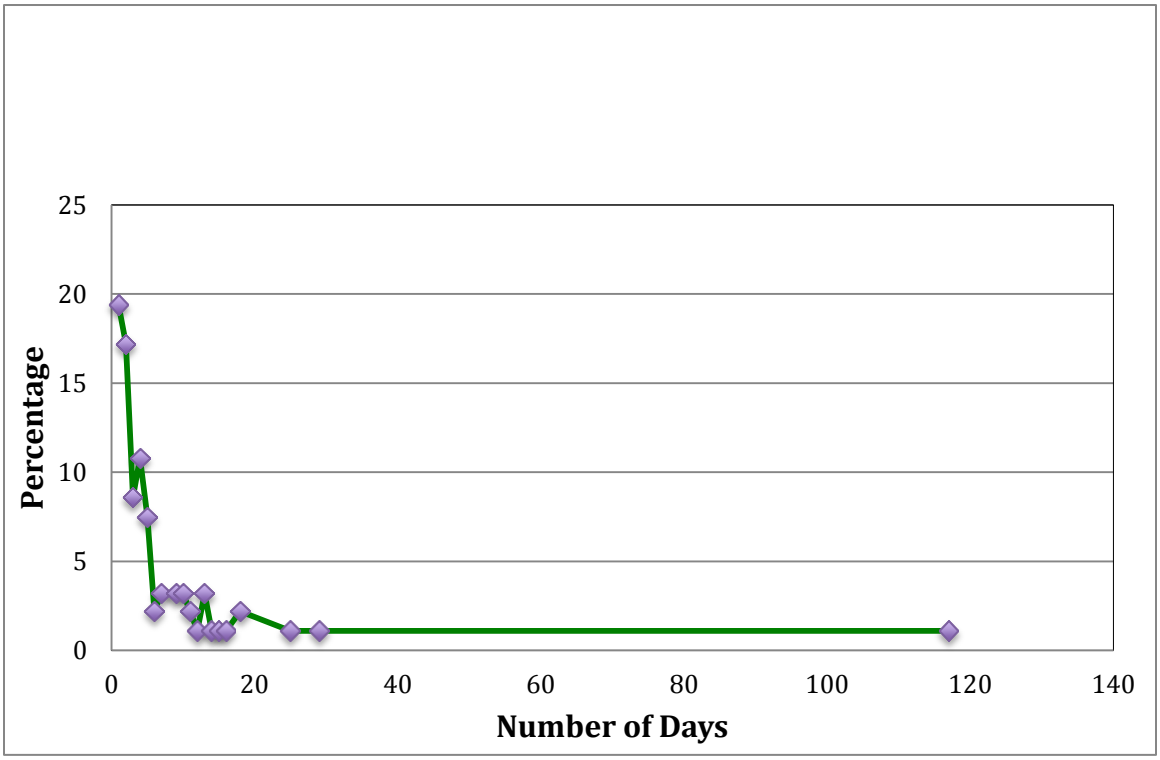
Primary Diagnosis



Length of stay Many children fall during the initial days that they are hospitalized (Figure 5). Over one-third (36.6%) of the children fell on the first or second day of their hospitalization. They are scared of the unknown place and are unaware of their surroundings. They are not used to being attached to equipment such as IV lines, tubes, and drains. The longer a child stays in the hospital the more likely they are at risk for falling due to boredom and curiosity.

Figure 5

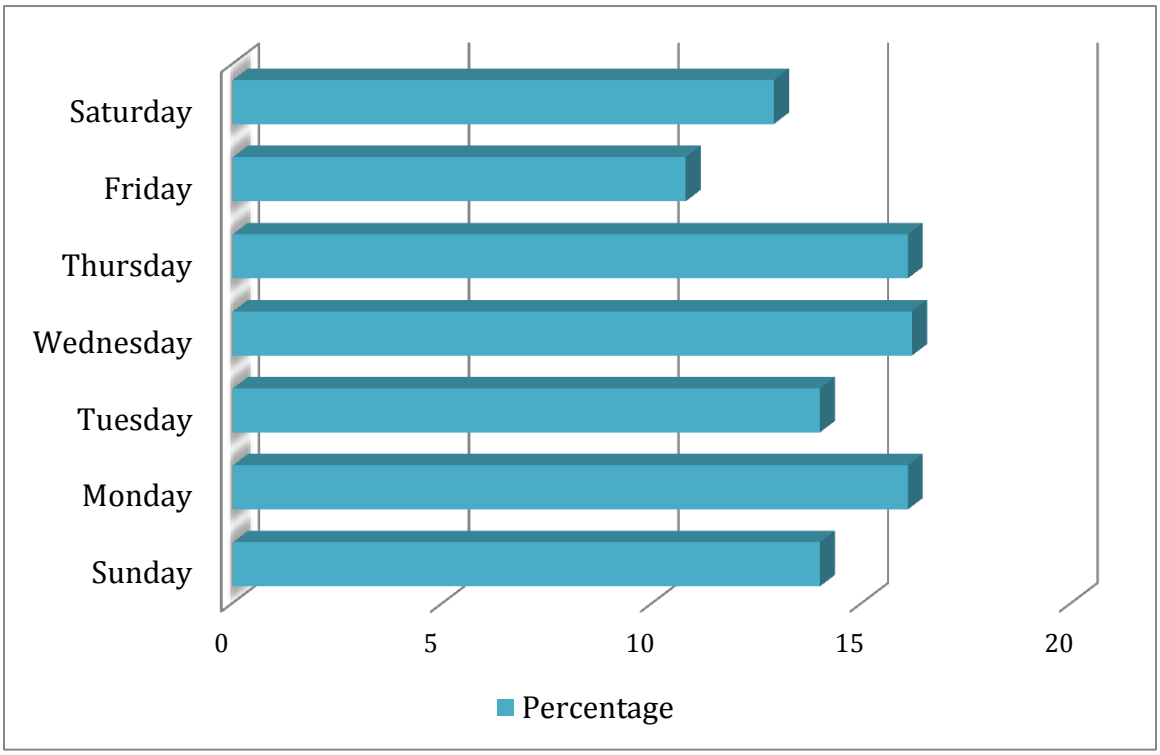
Length of Hospitalization in Days



Day of the week- There are no patterns of falls during days of the week (Figure 6).

Figure 6

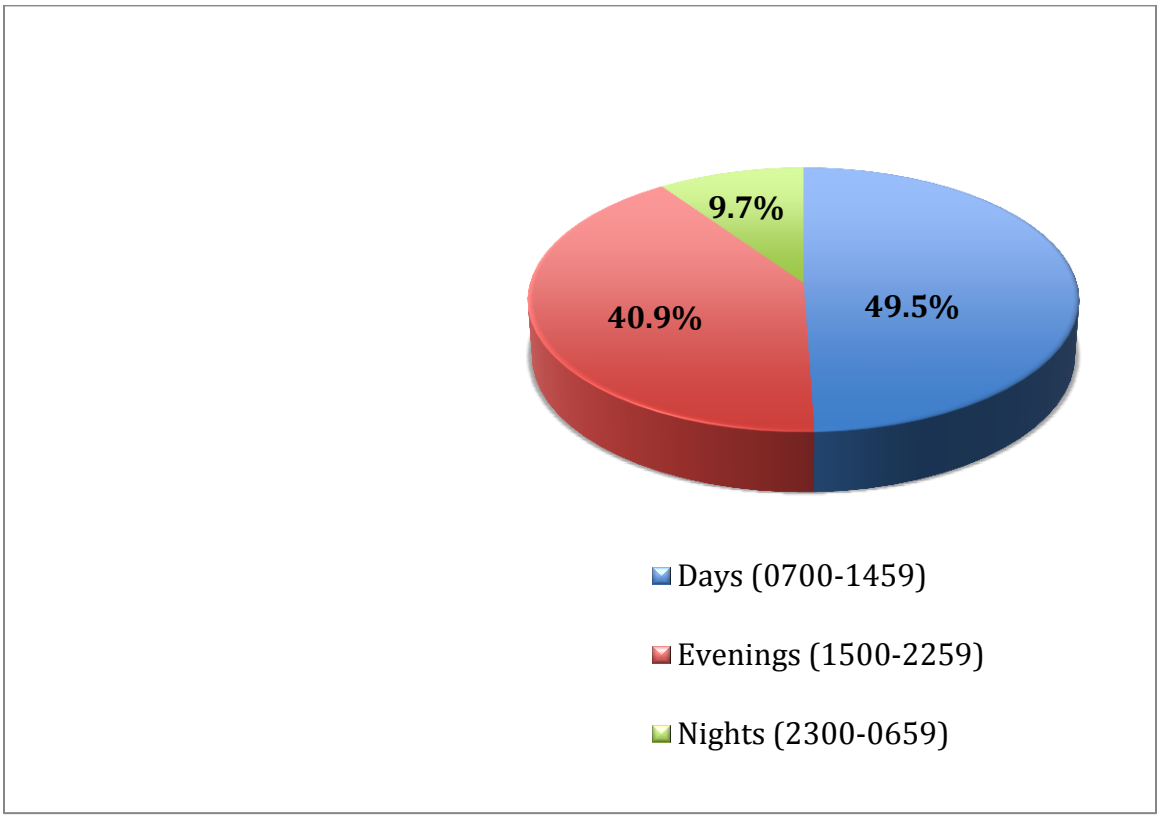
Day of the Week Child Fell



Shift of the fall- The children were more likely to fall (Figure 7) on day (49.5%) and evening shift (40.7%) rather than night shift (9.9%). Children are much more active during the day time and they want to get out of their bed to play. Children who fall during the night may do so due to the darkness of the room and they do not remember where they are during the middle of the night (unfamiliar surroundings), and they are scared.

Figure 7

Shift of the Fall



Parent Human Factors- Although 67.7% of falls were in front of at least one adult including parents and staff, the AERs rarely related factors including how parents and staff contributed to the fall. However, in 6 cases parents were distracted, in 5 cases parents were asleep, in 2 cases the parent was helping the child, and in 2 cases they were holding the patient. Parents experience a lot of stress while their child is in the hospital. Multi-tasking, sleep deprivation, other children at home, and dealing with work are stressors that some parents experience. Therefore, it is understandable that parents are distracted while their child is in the hospital. It is often an unknown experience for them as well (Board & Ryan-Wenger, 2002). There were a few AERs that stated factors related to staff contribution to the fall. In 2 cases the nurse was communicating with the parents. Also, in 2 cases, the nurse was working with equipment in the room. The staff focus was not on the patient during the time of the fall.

Location of the fall- As expected most falls (74.2%) occurred in the patient room. Children spend most of their room while they are hospitalized. Some children fell in the bathroom (6.5%) often due to the lack of requesting assistance. Hospital staff understand children's needs to be active and get out of their confined space so the take them somewhere to play. However, children still fall in the hallway (9.7%) and in the playroom (2.2%).

Fell from/fell onto- The majority of children fell to the floor from a standing position (41.9%). While it is important to encourage activity and ambulate, their normal skill may be compromised from their diagnosis or medications. Their self-protective mechanisms may be diminished. Nearly one-third (31.2%) of the children fell from their beds or cribs. These falls are more potentially serious because bed and crib heights in the hospital are

much higher than at home. Overall, 82.8% of children fell onto the floor that is linoleum over concrete. Thus, increasing the likelihood of injury.

Conclusions and Implications

These 93 cases of hospitalized children who fell from their beds, cribs etc.. represented a wide range of age groups, developmental status, and diagnosis. The information about the fall situation revealed child, caregiver, and parent human factors and environmental factors are consistent with the momentary confluence model. The clinical implications of these findings support an expansion of variables used to predict children's risk for falls. Further research based on the model may reveal patterns among the factors that predict risk for falls or fall related injuries.

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